

Serial No. 09/590,924Docket No. 55416US002

### Remarks

The Written Description and claims 20-22, 41 and 52 have been editorially amended. The application serial number at page 8, line 17 should have been "09/006085" rather than "09/006805", and has been corrected by insertion of a reference to the corresponding issued U.S. patent. The reissue number at page 89, line 20 should have been "34,605" rather than "3,034,605", and has been corrected by insertion of the correct reissue number. Claims 14-24 and 41-54 are pending.

### Rejection under 35 U.S.C. §112, second paragraph

In the Office Action, claims 14-24 and 41-54 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite on grounds that "In claims 14, 16, 41, 49, 52, the phrase "without substantial wrinkling" is vague and indefinite because it is unclear what constitutes "substantial" wrinkling." Applicants respectfully disagree. Page 25, lines 3-6 of applicants' Written Description states that "Substantially no wrinkling as used in this application means a lack of small ridges or furrows resulting from contraction of the smooth film surface that are detectable by the naked eye from a distance of less than about 1 meter, preferably less than about 0.5 meter." In view of this definition in the Written Description, those of ordinary skill in the art will readily understand the phrase "without substantial wrinkling". Applicants accordingly respectfully request to withdrawal of the rejection under 35 U.S.C. §112, second paragraph of claims 14-24 and 41-54.

### Rejection under 35 U.S.C. §103(a) over Wheatley et al. in view of Nishihara et al.

Claims 14-24 and 41-54 were rejected under 35 U.S.C. §103(a) as being unpatentable over Wheatley et al. (US 6,049,419) in view of Nishihara et al. (US 4,465,736), on grounds that:

"It would have been obvious to one of ordinary skill of the art at the time the invention was made to adjust shrinkage properties of the film of WHEATLEY ET AL '419 and to incorporate said shrinkable films into known laminate glass structures as disclosed in NISHIHARA ET AL in order to produce wrinkle-free infrared-reflecting transparent structures. One of ordinary skill in the art would have readily adjusted the heat-setting conditions of the film of WHEATLEY ET AL '419 to obtain the optimum shrinkage characteristics in various directions for particular laminate-

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forming conditions and glass curvatures as indicated in claim 24. It would have been obvious to incorporate conventional features into the laminate windshield such as a shade band layer as indicated in claim 46, 54 in order to minimize glare and improve visibility. Conventional windshields for automobiles and other vehicles typically have a degree of curvature as indicated in claims 50, 53."

Applicants respectfully disagree. Before turning to the rejection, some of the advantages of preferred embodiments of applicants' invention should be noted.

The films of applicants' invention are especially well suited for use as functional films (e.g., infrared-rejecting films) in non-planar glazing (e.g., vehicular glazing). Vehicular glazing is available in a wide variety of configurations, including planar configurations, curved configurations having a single radius of curvature, and compound curved configurations. To enhance vehicle aerodynamics and improve outward visibility, vehicle manufacturers have increasingly used complex (e.g., compound) curved glazing configurations (see, e.g., page 2, lines 15-16 of applicants' Written Description). However, it has turned out to be very difficult to laminate functional films into such complex curved glazing configurations, especially when the functional film is metallized (see e.g., page 2, lines 16-23).

Applicants' invention enables formation of substantially wrinkle-free laminates on curved surfaces including compound curved surfaces. Applicants can accomplish this by controlling the heat shrinkage characteristics of their films in at least one in-plane direction. Applicants provide extensive teaching regarding the desired extent of heat shrinkage and the manner in which the heat shrinkage characteristics can be controlled (see, e.g., page 22, line 8 through page 24, line 10). Applicants also teach that the shrinkage of their films can deliberately differ in two in-plane directions, thereby facilitating substantially wrinkle-free lamination of such films in compound curved glazing (see, e.g., page 22, lines 1-7). For example, in the words of applicants' claims 14 and 41, the film is "heat set at a temperature sufficient to render the film capable of shrinking to conform without substantial wrinkling to a substrate having a compound curvature", and in the words of applicants' claims 49 and 52, the film is "heat set at a temperature sufficient to render the film capable of shrinking to conform without substantial wrinkling to the non-planar glass layers." These claims do not merely recite a film that shrinks; they recite a film that has been "heat set at a temperature sufficient to

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render the film capable of shrinking to conform without substantial wrinkling”.

Applicants’ invention is not taught or suggested by the cited references.

Wheatley et al. discusses a wide variety of uses for its birefringent dielectric multilayer films, including polarizers (see e.g., col. 4, line 1 and col. 17, lines 1-43), mirrors (see e.g., col. 4, line 1 and col. 17, line 44 through col. 18, line 44), colored films (see e.g., col. 11, lines 40-51), security packaging films (see e.g., col. 24, lines 24-26) and IR reflecting films (see e.g., col. 18, line 45 through col. 19, line 12 and col. 32, line 30 through col. 33, line 7). Wheatley et al. also discusses the use of its films on a wide variety of glazing applications, including building windows (see, e.g., col. 7, lines 26-35; col. 27, line 59 through col. 28, line 19 and col. 32, line 30 through col. 33, line 7) and vehicular glass including windshields (see, e.g., col. 27, line 61 and col. 32, lines 42-45 and 55-60). However, Wheatley et al. does not explicitly teach processing its films so that they are “heat set at a temperature sufficient to render the film capable of shrinking to conform without substantial wrinkling”.

The optical properties of Wheatley et al.’s preferred films depend upon carefully-chosen optical thicknesses for the individual layers (see, e.g., col. 8, lines 15-57) and the relationship between the indices of refraction of each layer material in the x, y and z directions (see e.g., col. 16, lines 56-67). These index of refraction relationships preferably are established by biaxial stretching of the multilayer film (see e.g., col. 17, lines 11-14). Accordingly, stretching or shrinkage could change the optical properties of such a multilayer film, and thus normally would be *avoided* after fabrication of the film.

Wheatley et al. does discuss shrinkage of its films at col. 24, lines 17-26, saying that:

“The film is typically heat set in the last two zones of tenter oven 120 to impart the maximum crystallinity in the film and reduce its shrinkage. Employing a heat set temperature as high as possible without causing film breakage in the tenter oven 120 reduces the shrinkage during a heated embossing step. A reduction in the width of the tenter rails by about 1-4 % also serves to reduce film shrinkage. If the film is not heat set, heat shrink properties are maximized, which may be desirable in some security packaging applications.”

Thus although Wheatley et al. suggests reducing or minimizing heat shrinkage (except for security packaging applications), it does not explicitly recommend controlling heat shrinkage, employing heat shrinkage in functional films used for glazing laminates (esp cially compound curved glazing laminates) or employing differential heat shrinkage

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to facilitate formation of wrinkle-free compound curved glazing laminates. Applicants made these recommendations.

Resort to Nishihara et al. does not make applicants' claimed invention obvious. There would be no proper motivation to combine Nishihara et al. and Wheatley et al. Nishihara et al. doesn't say anything about birefringent dielectric multilayer films or about Wheatley et al. Nishihara et al. describes the use of metallized selectively light transmitting or electrically conductive functional films in laminated safety glass. Typically, such metallized functional films are formed by extruding, orienting and heat setting a plastic substrate, followed by a metallization step that places one or more thin metal or metal oxide layers atop the plastic substrate. The metallization layers are relatively fragile. Excessive stretching or shrinking of such a functional film after it has been metallized can lead to fracture or delamination of the metal or metal oxide layers. Accordingly, Nishihara et al. prefer to limit the heat shrinkage of the functional film (see, e.g., col. 4, lines 37-44).

According to the Office Action, Nishihara et al. discloses "a heat-shrinkable, selectively reflective film having a shrinkage of less than 5%". The cited text at col. 5, lines 19-55 of Nishihara et al. actually concerns Nishihara et al.'s interlayer film, not the functional film. The recited "interlayer film" is typically polyvinyl butyral (col. 5, lines 45-66).

Nishihara et al. actually imposes narrower limits on the functional film. According to Nishihara et al., the functional film can be heat shrinkable but both its heat shrinkage and its thickness must be limited according to the formula set out at col. 4, lines 5-11, and more preferably according to the formula set out at col. 4, lines 12-18.

A worker of ordinary skill in the art would not apply Nishihara et al.'s formulas to Wheatley et al.'s birefringent films. A worker of ordinary skill in the art would instead be influenced by the above-noted effect of stretching or shrinkage upon the optical properties of Wheatley et al.'s films, and would as noted above avoid such stretching or shrinkage after film formation. Thus notwithstanding the assertions in the Office Action, a worker of ordinary skill in the art would not "adjust shrinkage properties of the film of WHEATLEY ET AL '419" and would not "incorporate said shrinkable films into known laminate glass structures as disclosed in NISHIHARA ET AL in order to produce wrinkle-free infrared-reflecting transparent structures."

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The Office Action also asserts (emphasis added) that "One of ordinary skill in the art would have readily adjusted the heat-setting conditions of the film of WHEATLEY ET AL '419 to obtain the optimum shrinkage characteristics in various directions for particular laminate-forming conditions and glass curvatures". Wheatley et al. does not discuss films having optimum shrinkage characteristics in different directions. Some of Nishihara et al.'s films have different measured heat shrinkages in the transverse and machine directions (see, e.g., the films of Examples 2 through 4; compare the film of Example 1), but there is no suggestion or discussion anywhere in Nishihara et al. concerning the effect of such differences, nor of any advantage that might be obtained by optimizing shrinkage characteristics in different directions.

The Office Action asserts that "Conventional windshields for automobiles and other vehicles typically have a degree of curvature as indicated in claims 50, 53." The issue is not whether conventional windshields have a compound curvature; instead, the issue with respect to claims 50 and 53 is whether windshields having such a compound curvature can successfully incorporate a functional film layer that conforms without substantial wrinkling to the glass layers. Note, for example, that Nishihara et al. never actually exemplifies a wrinkle-free compound curved laminate. Instead, all of Nishihara et al.'s examples involved plate glass laminations having no curvature, or glass laminations having a simple (not compound) radius of curvature. For instance, Nishihara et al. Example 1 shows the preparation of two laminated glass articles. The first is made from two sheets of plate glass (col. 8, lines 17-19). The second is made from two pieces of simple curvature glass "having a radius of curvature of 3 cm and thickness of 2 mm" (col. 8, lines 33-38). The remaining Nishihara et al. examples and comparison examples do not always say if they used plate glass or simple curvature glass, but in each case the laminate is said to be prepared "according to" or "as" Example 1.

Wheatley et al. and Nishihara et al. are not properly combinable for the reasons outlined above. If combined, Nishihara et al.'s shrinkage and thickness limitations would not be utilized by one of ordinary skill in the art in the manner set out in the Office Action. Moreover, Nishihara et al. does not enable fabrication of a wrinkle-free compound curved laminate. Applicants accordingly request withdrawal of the rejection of claims 14-24 and 41-54 under 35 U.S.C. §103(a) over Wheatley et al. in view of Nishihara et al.

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**Rejection under 35 U.S.C. §103(a) over  
Nishihara et al. in view of Wheatley et al.**

Claims 14-24 and 41-54 were also rejected under 35 U.S.C. §103(a) as being unpatentable over Nishihara et al. in view of Wheatley et al., on grounds that:

"It would have been obvious to one of ordinary skill of the art at the time the invention was made to utilize the reflective film of WHEATLEY ET AL '419 into known laminate glass structures as disclosed in NISHIHARA ET AL and to make said film slightly shrinkable in order to produce wrinkle-free infrared-reflecting transparent structures. One of ordinary skill in the art would have readily adjusted the heat-setting conditions of the film of WHEATLEY ET AL '419 to obtain the optimum shrinkage characteristics in various directions for particular laminate-forming conditions and glass curvatures as indicated in claim 24. It would have been obvious to incorporate conventional features into the laminate windshield such as a shade band layer as indicated in claim 46, 54 in order to minimize glare and improve visibility. Conventional windshields for automobiles and other vehicles typically have a degree of curvature as indicated in claims 50, 53."

Applicants respectfully disagree, for the same reasons already set out above with respect to the rejection of claims 14-24 and 41-54 over Wheatley et al. in view of Nishihara et al. Rather than repeat them, applicants simply rely upon those reasons with respect to the rejection of claims 14-24 and 41-54 over Nishihara et al. in view of Wheatley et al. Applicants accordingly request withdrawal of the rejection of claims 14-24 and 41-54 under 35 U.S.C. §103(a) over Nishihara et al. in view of Wheatley et al.

**Conclusion**

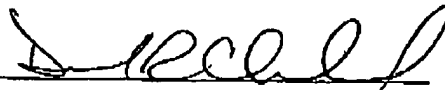
The 35 U.S.C. §112 rejection is overcome by language in applicants' Written Description. The 35 U.S.C. §103(a) rejections should be withdrawn, since neither cited reference, whether taken alone or in any proper combination, shows or suggests applicant's claimed invention. Accordingly, applicants respectfully request reconsideration and withdrawal of the rejections and passage of this application to the issue branch. The Examiner is encouraged to telephone the undersigned attorney at 651-251-2250 to discuss any remaining questions concerning this application.

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**Marked copy of March 26, 2002 amendments to paragraphs of the Written  
Description in USSN 09/590,924 (55416US002)''**

At page 1, lines 12-20:

The laminate may also include at least one functional layer engineered to enhance the performance of the vehicle window. One important functional layer reduces entry of infrared radiation into the vehicle cabin. Infrared rejecting functional layers are typically made of [metalized] metallized or dyed polymer film constructions that reflect or absorb unwanted solar radiation. When used in a windshield, the composite laminate structure should transmit at least about 70% of the light in the wavelength region sensitive to the human eye, typically from about 380 to about 700 nanometers (nm), and reject solar radiation outside the visible portion of the spectrum. When used in other glazing structures, such as side or rear windows, there are typically no limits on the level of visible transmission.

At page 2, lines 15-23:

To enhance vehicle aerodynamics and improve outward visibility, vehicular window shapes are not planar, and increasingly include severe angles and complex curves. When the laminate 10 is placed between complex curved glass sheets and laminated with a nip roll process, or heated to bond the PVB to the glass, the functional layer 12 cannot perfectly conform to the complex curvatures, especially when the glass sheets are large. Wrinkles, folds and pleats can form in the functional layer, and, when the functional layer is [metalized] metallized, cracks can form in the [metalized] metallized layer 16 during nip rolling, which creates an optical defect in the safety glazing. As a result, only small size laminates with no curvature or a small one-dimensional curvature can currently be manufactured using a nip roll process.

At page 4, lines 11-27:

For example, by selecting the layer thicknesses to reflect near infrared light, and positioning the reflective bandedge within the infrared region such that even at grazing angles of incidence the reflectance band does not shift into the visible region of the spectrum, an infrared mirror can be made that is transparent in the visible region of the spectrum, even at high angles of incidence. The infrared (IR) reflecting films described in



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U.S. Patent [No.] Nos. 5,882,774 and [in copending application U.S. Serial No. 09/005727] 6,049,419, each incorporated herein by reference, control the amount of solar energy that pass through them, preferably without significantly decreasing the intensity or changing the color of light sensed by the human eye at any angle. The materials in the layers, the thicknesses of the layers, and the indices of refraction of the layers are selected to reflect infrared radiation within the wavelength range of about 700 nm to about 2000 nm, while transmitting visible light. The film has an average reflectivity of at least 50% over a band at least 100 nm wide in the infrared region of the spectrum. These films have been applied to substantially flat substrates to form laminates. However, when applied to a non-planar substrate, wrinkles form in the film, so the films have not been used in laminates with severely curved or compound curved substrates. The wrinkles are a particular problem in laminates that should be substantially optically clear, such as, for example, laminates intended for use in vehicular windshields.

At page 8, lines 9-18:

To reflect over a wide band, the various layers in the film preferably have varying relative thicknesses, referred to herein as a layer thickness gradient, which are selected to achieve the desired bandwidth of reflection. In one embodiment, the layer thickness gradient may be linear, in which the thickness of the layer pairs increases at a constant rate across the thickness of the film, so that each layer pair is a certain percent thicker than the thickness of the previous layer pair. In another embodiment, the layer thickness may decrease, then increase, then decrease again from one major surface of the film to the other, or may have an alternate layer thickness distribution designed to increase the sharpness of one or both bandedges, as described in U.S. [Serial No. 09/006,805] Patent No. 6,157,490, which is incorporated herein by reference.

At page 9, lines 16-24:

In an alternate embodiment, IR reflecting films including more than two distinguishable polymers can be made. This extends the reflecting band further into the IR to increase the amount of IR reflection while minimizing color in the visible region of the spectrum, which results from reflection due to higher order harmonics. Examples of such films include those described in U.S. Patent No. RE [3,034,605] 34,605, incorporated

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herein by reference. The [RE '305] RE '605 patent describes a multilayer optical interference film including three diverse substantially transparent polymeric materials, A, B, and C and having a repeating unit of ABCB. The layers have an optical thickness of between about 90 nm to about 450 nm, and each of the polymeric materials has a different index of refraction,  $n_i$ .

At page 10, lines 4-10:

Another useful film design is described in U.S. [Serial No. 09/006,118] Patent No. 6,207,260, which is incorporated herein by reference. Optical films and other optical bodies are described which exhibit a first order reflection band for at least one polarization of electromagnetic radiation in a first region of the spectrum while suppressing at least the second, and preferably also at least the third, higher order harmonics of the first reflection band, while the percent reflection of the first order harmonic remains essentially constant, or increases, as a function of angle of incidence.

At page 13, line 20 through page 14, line 7:

A polyester useful in the solar rejection films of the present invention is polyethylene naphthalate (PEN), which can be made, for example, by reaction of naphthalene dicarboxylic acid with ethylene glycol. Polyethylene 2,6-naphthalate (PEN) is frequently chosen as a first polymer. PEN has a large positive stress optical coefficient, retains birefringence effectively after stretching, and has little or no absorbance within the visible range. PEN also has a large index of refraction in the isotropic state. Its refractive index for polarized incident light of 550 nm wavelength increases when the plane of polarization is parallel to the stretch direction from about 1.64 to as high as about 1.9. Increasing molecular orientation increases the birefringence of PEN. The molecular orientation may be increased by stretching the material to greater stretch ratios and holding other stretching conditions fixed. Other semicrystalline naphthalene dicarboxylic polyesters suitable as first polymers include, for example, polybutylene 2,6-Naphthalate (PBN), polyethylene terephthalate (PET), and copolymers thereof. Non-polyester polymers are also useful in creating polarizer films. For example, polyether imides can be used with polyesters, such as PEN and coPEN, to generate a multilayer reflective mirror. Other polyester/non-polyester combinations, such as polyethylene terephthalate and

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polyethylene (e.g., those available under the trade designation Engage 8200 from Dow Chemical Corp., Midland, MI), can be used. Suitable first polymers are described, for example, in [U.S. Serial Nos. 09/229724, 09/232332, 09/399531, and 09/444756] Published PCT Application Nos. WO 99/36248, WO 99/36262 and WO 01/38907, and in U.S. Patent No. 6,268,961, which are incorporated herein by reference.

At page 15, line 1 through page 16, line 6:

Preferred second polymers are homopolymers of polymethylmethacrylate (PMMA), such as those available from Ineos Acrylics, Inc., Wilmington, DE, under the trade designations CP71 and CP80, or polyethyl methacrylate (PEMA), which has a lower glass transition temperature than PMMA. Additional preferred second polymers include copolymers of PMMA (coPMMA), such as a coPMMA made from 75 wt% methylmethacrylate (MMA) monomers and 25 wt% ethyl acrylate (EA) monomers, (available from Ineos Acrylics, Inc., under the trade designation [Perspex] PERSPEX™ CP63), a coPMMA formed with MMA comonomer units and *n*-butyl methacrylate (nBMA) [comonomier] comonomer units, or a blend of PMMA and poly (vinylidene fluoride) (PVDF) such as that available from Solvay Polymers, Inc., Houston, TX under the trade designation [Solef] SOLEF™ 1008. Yet other preferred second polymers include polyolefin copolymers such as poly (ethylene-co-octene) (PE-PO) available from Dow-Dupont Elastomers under the trade designation [Engage] ENGAGE™ 8200, poly (propylene-co-ethylene) (PPPE) available from Fina Oil and Chemical Co., Dallas, TX, under the trade designation Z9470, and a copolymer of atactic polypropylene (aPP) and isotactic polypropylene (iPP) available from Huntsman Chemical Corp., Salt Lake City, UT, under the trade designation [Rexflex] REFLEX™ W111. Second optical layers can also be made from a functionalized polyolefin, such as linear low density polyethylene-g-maleic anhydride (LLDPE-g-MA) such as that available from E.I. duPont de Nemours & Co., Inc., Wilmington, DE, under the trade designation [Bynel] BYNEL™ 4105.

Particularly preferred combinations of first/second polymers for optical layers in IR reflective mirrors include PEN/PMMA, PET/PMMA or PET/coPMMA, [PEN/Ecdel, PET/Ecdel] PEN/ECDEL™, PET/ECDEL™, PEN/sPS, PET/sPS, PEN/coPET, PEN/PETG, and [PEN/THV] PEW/THV™. [Ecdel] ECDEL™ is a trade designation for a copolyester ether elastomer available from Eastman Chemical Company (Kingsport,

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TN). [THV] THV™ is a trade designation for a fluoropolymer commercially available from Minnesota Mining and Manufacturing Company (3M), St. Paul, MN. PMMA refers to polymethyl methacrylate, coPET refers to a copolymer or blend based upon terephthalic acid (as described above), and PETG refers to a copolymer of PET employing a second glycol (usually cyclohexanedimethanol). sPS refers to syndiotactic polystyrene.

For mirror films, a match of the refractive indices of the first polymer and second polymer in the direction normal to the film plane is preferred, because it provides constant reflectance with respect to the angle of incident light (that is, there is no Brewster's angle). For example, at a specific wavelength, the in-plane refractive indices might be 1.76 for biaxially oriented PEN, while the film plane-normal refractive index might fall to 1.49. When PMMA is used as the second polymer in the multilayer construction, its refractive index at the same wavelength, in all three directions, might be 1.495. Another example is the [PET/Ecdel] PET/ECDEL™ system, in which the analogous indices might be 1.66 and 1.51 for PET, while the isotropic index of [Ecdel] ECDEL elastomer might be 1.52.

At page 18, line 13 through page 19, line 20:

Various functional layers or coatings can be added to the films and optical devices of the present invention to alter or improve their physical or chemical properties, particularly along the surface of the film or device. Such layers or coatings may include, for example, low friction coatings or slip particles to make the film easier to handle during the manufacturing process; particles to add diffusion properties to the multilayer optical film or to prevent wet-out or Newton's rings when the multilayer optical film is placed next to another film or surface; adhesives such as pressure sensitive adhesives and hot melt adhesives, adhesion promoters, primers and low adhesion backside materials for use when the film is to be used in adhesive roll form. The functional layers or coatings may also include shatter resistant, anti-intrusion, or puncture-tear resistant films and coatings, for example, the functional layers described in commonly assigned [U.S. patent application] Published PCT Application No. WO 01/96115 entitled GLAZING ELEMENT AND LAMINATE FOR USE IN THE SAME, [3M File Number 55434USA1A.002,] incorporated herein by reference. Additional functional layers or coatings may include vibration-damping film layers such as those described in WO 98/26927 and U.S. Patent No. 5,773,102, barrier layers to provide protection or to alter the

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transmissive properties of the film or device towards liquids, such as water or organic solvents, or gases, such as oxygen, water vapor or carbon dioxide; and/or substrates and support layers designed to improve the mechanical integrity or strength of the film or device. These functional components may be incorporated into one or more skin layers, or they may be applied as a separate film or coating.

For some applications, it may be desirable to alter the appearance and/or performance of the multilayer optical film by coloring the film, such as by laminating a dyed film to the multilayer optical film, applying a pigmented coating to the surface of the film, or including a dye or pigment in one or more of the materials used to make the film, such as in the skin layer. The dye or pigment typically absorbs in one or more selected regions of the spectrum, including portions of the infrared, ultraviolet, and/or visible spectrum. The dye or pigment can be used to compliment the properties of the film, particularly where the film transmits some frequencies while reflecting others. A particularly useful pigmented layer that can be combined with the multilayer optical film of the present invention is described in [copending U.S. Application Serial No. 09/503,597] Published PCT Application No. WO 01/58989, which is incorporated herein by reference. This film may be laminated, extrusion coated or coextruded as a skin layer on the multilayer film. The pigment loading level may be varied between about 0.01 and about 1.0% by weight to vary visible light transmission from about 10 to about 90%. In practice, the pigment loading level is selected such that when the pigmented film layer is combined with the multilayer optical film, the percent visible transmission is reduced to about 80-85% of the multilayer optical film's normal value,  $T_{vis}$ , to the legal limit of about 70-75% measured at an angle normal to a laminate construction. This improves the overall shading coefficient of the multilayer film construction.

At page 21, lines 4-11:

The above IR rejecting multilayer optical films can be made according to U.S. Serial No. 09/229724, which is incorporated herein by reference. These films solve the problems of cracking that are typically seen when [metalized] metallized solar rejection films are nip roll laminated to glazings having compound curvature. The films may wrinkle during nip roll lamination, however, especially when applied to large laminates and/or glazings with severe compound curvatures. In another aspect of the present

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invention, the process conditions can be controlled to produce a film with improved shrinkage properties, resulting in a film that does not wrinkle during the nip roll lamination process.

At page 21, line 12:

Process for Making [Wrinkle Free] Wrinkle-Free IR Film

At page 22, lines 1-14:

If the non-planar substrate to which the film is to be laminated has a specific shape or curvature, to reduce wrinkling the shrinkage of the film may be individually controlled in each in-plane direction. If the curvatures along two principal axes of a region of the substrate are not equal, to laminate the film to that region without wrinkles, the shrinkage of the film may be controlled such that it differs in each in-plane direction. The in-plane direction of the film with the greater shrinkage should be aligned with the dimension of the substrate having the greater curvature (i.e., a smaller radius of curvature).

For example, to achieve substantially wrinkle-free lamination to a non-planar, curved or compound curved substrate, for a PEN or PET based film the shrinkage is greater than about 0.4% in both in-plane directions, preferably greater than about 0.7% in at least one in-plane direction, and more preferably greater than about 1% in at least one in-plane direction. The shrinkage should be maintained at a minimum to reduce edge delamination. This phenomenon is called a "pull-in." So, the shrinkage is preferably less than about 3% in each in-plane [direction] direction, more preferably less than about 2.5% in each in-plane direction.

At page 22, line 28 through page 23, line 11:

For example, typical heatset conditions for PEN based multilayer IR mirror films intended for lamination to a planar substrate are about 480°F. To control shrinkage and provide a film suitable for [wrinkle free] wrinkle-free lamination to a non-planar substrate, the heat set temperature for a PEN based multilayer IR mirror film should be reduced to about 390°F to about 400°F, preferably about 395°F, for about 10 seconds. The heat set temperature for a PET based multilayer IR mirror film suitable for lamination to a non-

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planar substrate should be about 440°F to 470°F, preferably about 455°F to about 465°F. for about 10 seconds.

In addition to the heatset temperature and residence time, another parameter that affects film shrinkage is toe-in. Toe-in is defined as the decrease in rail spacing in the tenter heatset zone measured relative to a maximum rail setting. For example, if maximum width of the film is 67 inches at the end of the stretch zone, and film width in the heatset zone is 65 inches, then the toe-in is 2 inches. The first rail in the heatset zone is preferably set between the maximum rail setting and the rest of the heatset zone rail settings to ensure a smooth transition. However, tenter rail [configuration] configuration and tenter width may vary widely, and ideal rail settings must be determined experimentally in each case.

At page 23, line 26 through page 24, line 2:

To control shrinkage and provide a film suitable for [wrinkle free] wrinkle-free lamination to a non-planar substrate, the toe-in should be adjusted depending on the polymer used. For a PEN based multilayer IR mirror film, the toe-in should be about 0 to 1.5 inches, preferably about 0.5 to 1 inches at the preferred heatset temperature, film width and heatset zone residence times mentioned above. For a PET based multilayer IR mirror film, the toe-in should be about 0 to 2 inches, preferably about 0 to 1.5 inches at the preferred conditions described above.

At page 25, lines 7-9:

If the multilayer IR film is laminated into a vehicular safety glazing laminate, the laminated structure will be substantially [wrinkle free] wrinkle-free, preferably optically clear, to the naked eye from a distance of less than about 1 meter, preferably less than about 0.5 meter.

At page 25, lines 17-29:

To ensure a substantially [wrinkle free] wrinkle-free lamination of the multilayer IR mirror film in a non-planar glazing article for a vehicle, such as a safety glazing laminate, the heating/cooling procedures and conditions in the lamination process should be carefully controlled. The temperatures used depend on the Tg of the polymeric components of the film and the viscosity and adhesion level of the mechanical energy

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absorbing layers, such as PVB, polyurethane (PUR) and [Surllyn] SURLYN™, to the film. The preferred mechanical energy-absorbing layer is PVB. Preferably, some level of adhesion should be established between the PVB, the film and the non-planar glazing sheet(s) before the film shrinks during the pre-heating and de-airing process. However, the PVB should preferably not become sufficiently soft to flow before the film shrinks. The PVB should tack the edges and hold the IR film in position while the film shrinks and forms to the shape of the laminate. The laminate should be cooled after autoclaving at a controlled rate to avoid possible wrinkling due to the recovery of thermal expansion of the IR film and possible delamination on the edges.

At page 26, lines 12-19:

To bond the PVB and IR film layers or the pre-laminate 110 or 140 to the glazing sheets 130, 132, the layers of PVB and IR film or the pre-laminate and the glazing sheets are assembled by placing them atop one another to form a unitary laminate structure 134. The layers of the laminate 134 are then bonded together and air is removed from the construction. During this step it is preferable to heat the laminate construction in an oven to a temperature below the T<sub>g</sub> of the dominant polymer in the IR film 112. This allows the PVB layers 118, 120 to build some adhesion with the film 112 or the glass 130, 132 while the film 112 shrinks to [from] form to the shape of the laminate.

At page 28, line 21 through page 29, line 7:

The unprimed multilayer IR film samples were placed in glass/PVB/film/PVB/glass windshield laminates with compound curvatures. The DW 1224 windshield was intended for use in a model 1999 minivan manufactured by [Daimler-Chrysler] Daimler-Chrysler Corporation, Auburn Hills, MI, and has dimensions of 43 inches (109 cm) by 60 inches (152 cm). The TD direction of the film corresponded to the height of the windshield. Lamination trials were conducted using a vacuum de-airing process. Each laminate was prepared in a clean room. The laminates were wrapped with Ace bandages and then placed in a plastic bag. Once the bag was sealed, the laminate was de-aired by placing the bag under a vacuum of about 25 inches Hg at room temperature for minimum of 15 minutes. The laminates were then heat tacked in an oven at 220°F for about 45 minutes. After removal from the oven, the edges were sealed with a



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glycol ether sealant available from Dow Chemical, Midland, MI under the trade designation [Dowanol] DOWANOL™, and the laminates were placed in an autoclave. The startup temperature of the autoclave was about 100°F, and within about 17 minutes, the temperature increased to about 275°F and remained at that temperature for about 15 minutes. While the temperature was increasing, the pressure in the autoclave was also increased from room pressure to about 200 psi within about 19 minutes and remained at that level. After heat soaking was completed, the temperature was reduced to about 100°F within about 10 to 15 minutes. At about the same time, the pressure was also reduced to atmospheric pressure.

At page 29, lines 10-14:

The windshield lamination results in Table 1 demonstrate that the film samples made at a lower tenter heat set temperature, less than about 440°F, preferably about 410°F or less, increased shrinkage of the film and resulted in a laminate with fewer or no wrinkles. [Wrinkle free] Wrinkle-free lamination may be achieved when shrinkage is at least about 0.7% in both the MD and TD, preferably greater than about 1%.

At page 29, line 16 through page 30, line 14:

A multilayer IR mirror film with 224 microlayers was prepared. The layers alternated between a first polymer of coPEN (90%PEN/10%PET) from 3M and a second polymer of PMMA CP80 from Ineos Acrylics. The film also included coPEN skin layers on the exterior of the multilayer stack. The thickness of the skins and PBLs as a percentage of the total film construction prior to lamination is listed in Table 2. The film was orientated first in the MD direction in a length orienter with a stretch ratio of about 3.3:1 and then in the TD direction in a tenter with a stretch ratio of about 4.0:1. The temperatures in the tenter were: preheat zones 275°F, stretch zones 280°F and cooling zones 120°F. The residence time in the heatset zone was approximately 10 seconds. The heatset temperature and toe-in conditions are listed in Table 2 below, along with the shrinkage properties of the film samples. Selected, unprimed film samples from a designed experiment were laminated into a windshield (DW1218) intended for use in a 1999 Taurus automobile manufactured by Ford [MotorCompany] Motor Company, Dearborn, MI. The windshield had compound curvatures and dimensions of 40 inches (102 cm) by 63 inches (160 cm).

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Sample were cleaned and prepared under standard production conditions. Two layers of 15 mil (0.038 cm) Dupont B14 PVB were used with IR film sandwiched in between and with one piece of glass on each outer side. After the entire construction was laminated and trimmed, a ring seal gasket was placed around the edge of the windshield and a vacuum was applied to the construction to remove air. While vacuum was applied, the laminate entered a warming oven for about eleven minutes at a temperature of about 212°F. After leaving the warming oven, the ring seal was removed and the samples were placed onto a holding rack.

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**Marked copy of March 26, 2002 amendments to the claims  
in USSN 09/590,924 (55416US002)**

20. (amended) A birefringent dielectric multilayer film that reflects at least 50% of light in a band at least 100 nm wide in a wavelength region of interest, wherein the film is heat set at a temperature sufficient to enable the film to shrink at least about [0.4 %] 0.4% in both in-plane directions upon heating.

21. (amended) The film of claim 20, wherein the wavelength region of interest is from about 700 nm to about 2000 nm.

22. (amended) The film of claim 20, wherein the film is heat set at a temperature sufficient to enable the film to shrink at least about 0.7% in at least one in-plane direction upon heating.

41. (amended) A pre-laminate comprising a first layer of an energy absorbing material and a layer of a film, wherein the film layer comprises a birefringent dielectric multilayer film that reflects at least 50% of light in a band at least 100 nm wide in a wavelength region of interest, wherein the film is heat set at a temperature sufficient to render the film capable of shrinking to conform without substantial wrinkling to a substrate having a compound curvature.

52. (amended) A vehicle comprising an optically clear laminate article comprising the following layers: a first non-planar layer of glass, a first layer of PVB, a film layer, a second layer of PVB and a second non-planar layer of glass, wherein the film layer comprises a birefringent dielectric multilayer film that reflects at least 50% of light in a band at least 100 nm wide positioned between wavelengths from about 700 nm to about 2000 nm, wherein the film is heat set at a temperature sufficient to render the film capable of shrinking to conform without substantial wrinkling to the non-planar glass layers[.].